ARTICLE

Brain Death

Understanding of the Conceptual Basis by Pediatric Intensivists in Canada

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Objective: To determine whether pediatric intensivists in Canada are aware of the controversies regarding the concept of brain death (BD).

Design: Prospective survey.

Setting: From February to April 2004, a survey was mailed to each intensivist in the 15 pediatric intensive care units across the 8 provinces of Canada.

Participants: Sixty-four practicing pediatric intensivists.

Main Outcome Measures: Response rate, conceptual reasons to explain why BD is equivalent to death, and clinical findings that exclude a diagnosis of BD.

Results: Of the 64 surveys, 54 (84%) were returned. When asked to choose a conceptual reason to explain why BD is equivalent to death, 26 (48%) chose a higher brain concept, 17 (31%) chose a prognosis concept, and only 19 (35%) chose a loss of integration of the organism concept. More than half the respondents answered that BD is not compatible with electroencephalographic activity, brainstem evoked potential activity, or some cerebral blood flow. More than a third of respondents answered that a brainstem with minimal microscopic damage was not compatible with BD. Of the 36 respondents who answered they were comfortable diagnosing BD because "the conceptual basis of brain death makes it equivalent to death of the patient," in their own words, only 8 (22%) used a loss of integration of organism concept, 9 (25%) used a prognosis concept, 7 (19%) used a higher brain concept, and 13 (36%) did not articulate a concept.

Conclusions: There is significant confusion about the concept of BD among pediatric intensivists in Canada. The medical community should reconsider whether BD is equivalent to death.

Arch Pediatr Adolesc Med. 2006;160:747-752

Brain death (BD) is medically and legally equivalent to death of the patient in most developed countries in the world.[1] Brain death is defined as the irreversible loss of critical functions in the entire brain, including the brainstem.[2] This, the many supporters of BD have argued, is considered to be conceptually equivalent to death because the brain is necessary for maintaining the integrative unity of the body.[3] Without the brain functions, it is claimed, the body functions will disintegrate. There are 2 justifications used to confirm that BD is irreversible and equivalent to death: the inevitability of cardiac arrest and somatic death within days and the pathologic verification of complete brain destruction in BD.[4,5] Higher BD, or neocortical death, with death of the "essence" or "soul" of humans or consciousness (but with preservation of brainstem function) is not BD, and is not accepted in any country medically or legally as equivalent to death of the patient.[3]

There are many problems with these statements about the concept of BD. Brain functions may continue in many brain-dead brains. For example, electroencephalographic (EEG) activity is documented in more than 20% of brain-dead patients,[6,7] evoked potentials are documented in more than 5% of brain-dead patients,[8,9] cerebral blood flow is documented in more than 5% of brain-dead patients,[10,11] diabetes insipidus does not occur in more than half of brain-dead patients,[12-14] and pituitary hormones (including hypothalamic hormones) are present in some studies in most of the brain-dead patients.[14] Moreover, somatic survival of patients with BD for months and years has been reported,[15] disproving the hypothesis that "loss of integrative function" of the brain leads to disintegration of the body.[16,17] Finally, pathologic destruction is not seen in at least 10% of brain-dead patients' brains, even when they have been maintained with circulation for more than 24 hours after BD occurred.[4,5,13,18-21]

These problems relate to the important components of a formulation about

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death.[22,23] A definition of death at the conceptual level is needed so that the question "criteria or tests of what?" can be answered.[22] A criterion for this definition of death is needed and, finally, bedside clinical tests that confirm this criterion is met are required.[22,23] In the case of BD as accepted, the definition of death is the irreversible absence of the body's capacity to organize and regulate itself.[3,22,23] The criterion for this definition is the cessation of whole-brain functioning.[3,22,23] The tests used are the medically accepted bedside tests to confirm BD.[24] The problems previously outlined involve these relationships. Questions arise about the loss of bodily integration in BD (the definition); about the pathologic destruction of the brain or persistent EEG, evoked potential, and hormonal activity of the brain (the criterion); and whether tests for BD ignore some persisting brain activity and integration (the tests). This study was designed to determine if staff pediatric intensivists in Canada, who pronounce BD frequently in the pediatric intensive care unit, are aware of these controversies.

METHODS

QUESTIONNAIRE ADMINISTRATION

This study was a prospective survey of pediatric intensivists' opinions regarding BD issues. Research staff created a mailing list of all practicing staff pediatric intensivists at the 15 pediatric intensive care units across Canada. Each staff intensivist was mailed the survey in February 2004, with a $2 gift certificate "so you can get a coffee while you fill out the questionnaire." A cover letter was sent asking to fill in the survey and mail it back in the self-addressed and stamped envelope. A second and third mailing was done at 3-week intervals to nonresponders. The cover letter stated "we are sending you a short questionnaire asking you your opinions around some of the concepts surrounding brain death determination. There are no right or wrong answers to the questions. We simply want to sample the opinions of pediatric intensivists across Canada regarding the concept of brain death. Your responses are voluntary and confidential." The study was approved by our university health research ethics board before mailing.

QUESTIONNAIRE DEVELOPMENT

To generate the items for inclusion in the questionnaire, we searched MEDLINE from 1966 to 2004 for articles on BD, followed by review of the relevant article reference lists. Emphasis was placed on articles discussing the concept of BD, rather than the tests used to diagnose BD. Seven questions were generated, each with multiple possible answer boxes, with the instruction "in each question you may choose any/all of the responses that you consider correct." An additional question asked for a response in the practitioner's own words. The questionnaire started with the statement "All questions apply to a 14-year-old patient after severe head trauma in a motor vehicle collision. The patient fulfills all clinical brain death criteria unequivocally, including the suitable interval (in this case, 12 hours)." This statement was intended to convey that the tests for BD are not the focus of the study; rather, the concept is the issue. To ensure clarity, realism, validity, and ease of completion of the questionnaire, initial pilot testing of the instrument was done by having 5 local pediatric intensivists, 1 local pediatrician, and 1 local organ donation coordinator fill out the questionnaire. This was followed by a semistructured interview by us for feedback on the clarity of the questions and possible responses, and to confirm answers chosen reflected the intended response to the question. After minor modification, the questionnaire, 1 double-sided page, was mailed as previously described. The survey is available online (eFigure; available at http://www.archpediatrics.com).

ANALYSIS

Certain definitions were agreed on a priori for 2 of the survey questions. The first question asked the respondent to choose from a list "stand-alone" reason(s) that "is/are an acceptable *conceptual* reason to explain why 'brain death' is equivalent to 'death.'" The seventh question asked, "This patient fulfills all brain death criteria unequivocally, including the suitable interval. *Conceptually*, why are they dead (ie, in your own words, what is it about loss of brain function including the brainstem that makes this patient dead)?" For analysis, we classified responses into categories that have been discussed in the literature: loss of integration concept of BD, higher brain concept of BD, prognosis concept of BD, and statement of the criterion only. Further detail is provided in the eFigure. We hypothesized that there would be variability in the stated conceptual reasons to explain why BD is equivalent to death and in the stated clinical findings that exclude a diagnosis of BD. In addition, it was hypothesized that most respondents would not state the medically accepted conceptual reason to explain why BD is equivalent to death or the clinical findings that exclude a diagnosis of BD.

Anonymous data were entered into a computer database (Microsoft Excel; Microsoft Corp, Redmond, Wash). We analyzed responses using standard tabulations. Qualitative variables expressed as percentages were used to report the proportion of respondents with the different answers.

RESULTS

Surveys were mailed to all 64 practicing staff pediatric intensivists in 15 pediatric intensive care units across 8 provinces of Canada. Of the 64 surveys mailed, 54 (84%) were returned after the third mailing.

The first question asked which of several possibilities is an acceptable stand-alone conceptual reason to explain why BD is equivalent to death. Only 19 (35%) chose a loss of integration concept (**Table 1**).

The next 2 questions asked about which objective test results would not be compatible with BD. More than half answered that BD is not compatible with EEG activity that is not due to artifact (30 respondents [56%]); some visual, somatosensory, or auditory evoked potential activity (31 respondents [57%]); or some cerebral blood flow on technetium flow study (33 respondents [61%]). A significant minority also answered that normal regulatory pituitary hormones (3 respondents [6%]) and normal appearance of the brainstem grossly and microscopically (7 respondents [13%]) were not compatible with BD. In a patient who was brain dead for at least 48 hours, many answered that a brainstem (19 respondents [35%]) or cerebral cortex (13 respondents [24%]) that is structurally normal and microscopically with minimal damage was not compatible with BD; some (4 respondents [7%]) extended this to include a more moderately damaged brain (brainstem and cerebral cortex damaged; however, there are not widespread destructive changes typical of "respirator brain").

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Table 1. Responses to the Question on Conceptual Reasons to Explain Why Brain Death Is Equivalent to Death*

Conceptual Reason	No. (%) of the 54 Respondents
Higher brain concept	26 (48)
Irreversible loss of consciousness	17 (31)
Irreversible loss of the soul or "the essence" of humans	12 (22)
Irreversible loss of "personhood"	14 (26)
Irreversible loss of the integration of body functions by the brain	19 (35)
Prognosis concept	17 (31)
The certainty of cardiac arrest within hours or days	11 (20)
Further care is futile and/or degrading	12 (22)
Statement of loss of brain function (the criterion)	44 (81)
Irreversible loss of the function of the entire brain, including the brainstem	30 (56)
Irreversible loss of the critical functions of the entire brain, including the brainstem	34 (63)
Irreversible loss of the capacity for consciousness plus irreversible loss of the capacity to breathe	22 (41)
Irreversible destruction of the brain, including the brainstem	16 (30)

*The exact question asked was as follows: "Which of the following is/are an acceptable *conceptual* reason to explain why 'brain death' is equivalent to 'death' "? Respondents could choose more than 1 answer; each answer had to be a stand-alone reason.

Table 2. Response to the Question About What, in the Respondent's Own Words, Makes a Patient Dead*

Concept Given to Justify Why Brain Death Is Death	No. (%) of the 54 Respondents
Higher brain concept	9 (17)
Loss of integration of body concept	12 (22)
Loss of integration alone	6 (11)
Loss of integration combined with higher brain concept	6 (11)
Prognosis concept	12 (22)
Prognosis of death certain	7 (13)
Quality-of-life statement	5 (9)
Statement only: loss of brain function (the criterion)	13 (24)
No response (blank)	6 (11)
Other†	3 (5)

*The exact question was as follows: "This patient fulfills all brain death criteria unequivocally including the suitable interval. *Conceptually*, why are they dead (ie, in your own words, what is it about loss of brain function including the brainstem that makes this patient dead)?"

†Responses included "common sense," "it will not come back (no improvement)," and "life ≠ beating heart."

The next 3 questions asked about the timing of BD in different patient situations. When faced with a patient who has EEG activity yet fulfills all BD criteria, 15 (28%) would not consider the patient dead until the EEG became isoelectric 12 hours later. When faced with a pregnant brain-dead patient who is supported for 11 weeks until delivery, most agreed that the patient was brain dead by the second clinical BD examination (51 respondents [94%]); however, 3 respondents (6%) answered that the patient was not brain dead until after organs are harvested and the ventilator is stopped. When faced with a brain-dead patient who has no cerebral blood flow, yet a family that insists on continued "life support," only 25 respondents (46%) would tell the family that the patient is legally dead and that ventilation and inotropes will be withdrawn at a specified time; 20 respondents (37%) would continue support knowing that the patient will have a cardiac arrest soon (4 respondents [7%]) or to honor the family wishes (16 respondents [30%]). Most respondents answered that BD occurred after the second examination rather than after the first examination (22 respondents [41%] vs 16 respondents [30%] in the patient with EEG activity; and 27 respondents [50%] vs 24 respondents [44%] in the pregnant patient).

The next 2 questions asked again about the underlying conceptual basis of BD ("in your own words, what is it about loss of brain function including the brainstem that makes this patient dead?" and "prior to this survey, had you thought about why, at a conceptual level, brain death is equivalent to death of the patient?"). Of the respondents, 5 (9%) had not previously thought about why BD is equivalent to death. In their own words, only 12 (22%) used a loss of integration concept (**Table 2**). Finally, a question asked which choice "best describes why you are comfortable diagnosing death based on the criteria of brain death"; 36 (67%) responded "the conceptual basis of brain death makes it equivalent to death of the patient." Many responded that the reason is because it is a standard (22 respondents [41%]): an accepted medical standard (13 respondents [24%]), an accepted legal standard (14 respondents [26%]), and/or "the diagnosis of brain death was taught to me during my training" (3 respondents [6%]); only 1 respondent (2%) was not comfortable diagnosing death based on BD.

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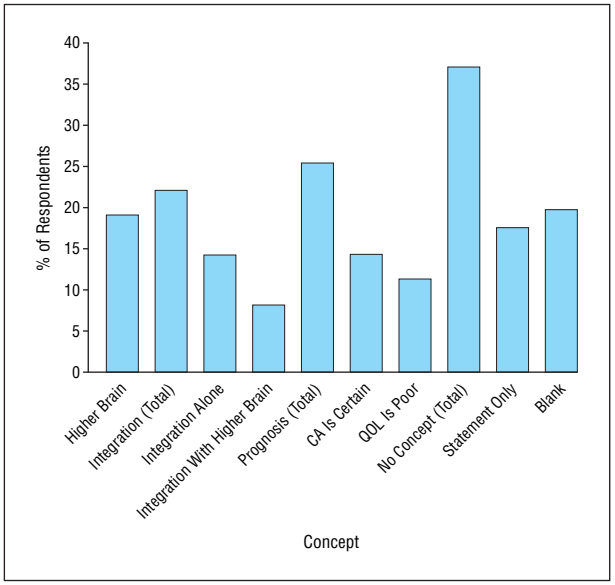

Figure. Concept used to justify brain death, used by the 36 respondents who agreed the conceptual basis makes brain death equivalent to death. The exact question asked was as follows: "This patient fulfills all brain death criteria unequivocally including the suitable interval. Conceptually, why are they dead?" CA indicates cardiac arrest; QOL, quality of life.

Further analysis was done for those 36 respondents (67%) who answered that they were comfortable diagnosing BD because "the conceptual basis of brain death makes it equivalent to death of the patient." Their response to the question asking to state the concept of BD in their own words is shown in the **Figure**. Only 8 (22%) used a loss of integration of body concept, and 13 (36%) did not articulate a concept (ie, used a statement of the criterion or left no response). On the first question, only 13 respondents (36%) considered "irreversible loss of the integration of body functions by the brain" as an acceptable conceptual reason to explain BD being equivalent to death and 11 (31%) considered a prognosis concept acceptable. Finally, when asked by family to continue "life support" on a brain-dead patient, 11 respondents (30%) would honor these wishes of the family.

COMMENT

Brain death was defined originally to address 2 issues related to progress in intensive care: the need to withdraw ventilator support (ie, demand of scarce medical resources) in those patients with irreversible coma and advances in organ transplantation.[25,26] To define BD as death allowed withdrawal of intensive care and harvesting of organs for transplantation. Only after the clinical BD state was described was the underlying conceptual justification for it being equivalent to death of the patient described,[23] and endorsed by the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research[3]: the loss of integrative unity of the organism. This state was said to be present when there was irreversible loss of the functions of the entire brain, including the brainstem.[3]

In time, brain-dead patients who had persistent brain function were described, including EEG, evoked potential, and antidiuretic hormone activity.[6-13] Therefore, the BD criterion was adjusted to refer to the loss of the "critical functions" of the brain as a whole,[2] although who decides what is a critical function was debated.[22,27,28] Recently, it has been found that brain-dead bodies can "survive" for prolonged periods.[15] This and other arguments have shown that the BD state does not necessarily mean loss of integrative unity of the organism with resultant somatic death shortly thereafter.[16,17] In addition, the underlying reasons for "needing" a definition of BD are less needed: intensive care is withdrawn frequently from patients who are not brain dead and have a poor prognosis and organ donation occurs from non–heart-beating and living donors.

This survey documented significant confusion about the officially accepted concept of BD among pediatric intensivists in Canada. Only a minority (19 respondents [35%]) considered loss of integrative function of the organism a conceptual justification for BD. Many considered prognosis a conceptual justification for BD (17 respondents [31%]); however, imminent cardiac arrest or futile or degrading therapy is not justification for defining someone as already dead, even though the patient may be considered "as good as dead." Many used a higher brain concept of death (26 respondents [48%]), suggesting that permanent lack of consciousness or "personhood" is a concept of death. Although this has been suggested by a few ethicists,[29] it is not accepted by medical or legal bodies,[3,28] and would imply that patients in a permanent vegetative state or anencephalic infants could be cremated or buried while still awake, breathing, and moving.[14] The results were similar when asked to answer the following, "in your own words, what is it about loss of brain function including the brainstem that makes this patient dead?" Only 12 respondents (22%) used a loss of integration concept, 12 (22%) used a prognosis concept, and 13 (24%) used a statement that there is loss of brain function (the criterion of death, not the definition).

The conceptual confusion demonstrated in this survey included illogical statements, as in saying that a person is dead because the person will die soon, and philosophical differences of opinion, such as saying that loss of consciousness is death. Whether the philosophical differences of opinion reflect consideration of all the nuances of the various arguments cannot be answered by this survey. However, it would seem that the physicians are not well-informed of the philosophical debates about the concept of BD. In support of this is the finding that, when faced with a brain-dead patient who has no cerebral blood flow, yet a family that insists on continued "life support," 20 respondents (37%) would continue support. This is remarkably similar to a recent survey that asked 25 pediatric critical care attending physicians if "life supports should be withdrawn from a child who is legally brain dead even if the parents do not agree"; 34% responded that they disagree or are uncertain.[30] If similar support would not be continued on a patient after irreversible circulatory death, this suggests that BD is different from death.

There was also confusion regarding brain functions and pathologic features that are compatible with the accepted clinical criterion and tests for diagnosis of BD. More

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than half of respondents were not comfortable with the diagnosis of BD when there was any EEG activity, evoked potential activity, or cerebral blood flow, even though this is the case in 5% to 20% of patients diagnosed as being brain dead.[6-11] Many were not comfortable with the diagnosis of BD when there was only minimal brain pathologic damage, even though this is the case in at least 10% of patients diagnosed as being brain dead.[4,5,13,18-21] These concerns were reflected in the response to some specific patient scenarios that fulfilled all clinical tests for BD: 15 respondents (28%) would not diagnose BD until the EEG was isoelectric, 3 (6%) would not diagnose the pregnant patient as dead until after delivery of the neonate and the ventilator was turned off, and 16 (30%) would honor family requests to continue intensive care treatment of the brain-dead patient. Electroencephalography is not considered a confirmatory test in Canada, because it cannot test brainstem function; however, this ignores the common concern that cortical function on EEG may not be compatible with BD in the minds of those making the diagnosis. Because it is unlikely that the physicians were unaware of the legal requirements for BD, this empirical confusion demonstrates that many physicians were not aware of the problems with the BD tests themselves. The BD tests do not diagnose an irreversible loss of the function of the entire brain.

We found that 36 (67%) respondents were comfortable diagnosing death based on the tests of BD because "the conceptual basis of BD makes it equivalent to death of the patient." This subgroup of respondents demonstrated similar confusion about the concept of BD. Only 8 respondents (22%) used a loss of integration concept, 9 (25%) used a prognosis concept, 7 (19%) used a higher brain concept, and 13 (36%) did not articulate a concept (ie, used a statement of the BD criterion or left no response).

The strengths of this survey include the high response rate (54 [84%] of 64 subjects) and the rigorous survey development methods, including pretesting confirming the clarity of the questions and possible responses. The multicenter representation also enhances the generalizability of our findings. The limitations of the survey include the lack of demographic data on the respondents and the lack of open-ended questions allowing respondents to expand on their intended answers. In addition, there could be discrepancies between stated and actual practice regarding BD. However, we believe that these limitations would not affect the main conclusion of this study, that there is a limited awareness of the debates surrounding the BD concept among staff pediatric intensivists.

Others have found similar results in surveys of physicians and nurses[31-35] and, therefore, we believe the results herein can be generalized to the medical community beyond pediatric intensivists in Canada. For example, in 1989, Youngner et al[31] showed that one third of physicians and nurses involved in the management of brain-dead patients considered them dead because they had irreversible loss of cortical function, and another third because they had an unacceptable quality of life or were irreversibly dying. This lack of change in confusion over 35 years is concerning, and may reflect the irresistible utilitarian appeal of the BD diagnosis or ambivalence regarding the conceptual status of persons who are brain dead.

Many have elegantly discussed the inconsistencies in the concept of BD,[14,16,17,27,28,36-40] and to elaborate further herein is beyond the scope of this study. The discussion has been confined to academic ethics and philosophy communities,[41] and has not been seriously considered by the clinical medical community. This study confirms a limited knowledge among clinicians of the conceptual basis for BD and of the empirical problems with the tests used to confirm BD. The BD criterion does not fulfill the official theory for the definition/concept of death, and the tests used do not fulfill the criterion of BD. For these reasons, we and others[27,28,36,38,41,42] believe it is time for the medical community to reconsider whether BD is equivalent to death of the patient.

Accepted for Publication: January 6, 2006.
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Author Contributions: *Study concept and design:* Joffe and Anton. *Acquisition of data:* Joffe and Anton. *Analysis and interpretation of data:* Joffe. *Drafting of the manuscript:* Joffe. *Critical revision of the manuscript for important intellectual content*: Joffe and Anton. *Statistical analysis:* Joffe. *Administrative, technical, and material support:* Joffe and Anton.
Financial Disclosure: None reported.
Additional Resources: The eFigure is available at http://www.archpediatrics.com.

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Brain Death Questionnaire

All questions apply to a 14-year-old patient after severe head trauma in a motor vehicle collision. ***The patient fulfills all clinical brain death criteria unequivocally, including the suitable interval (in this case, 12 hours).*** In each question, you may choose ***any/all*** of the responses that you consider correct. Please answer the questions on both sides of this page.

1. Which of the following is/are an acceptable *conceptual* reason to explain why "brain death" is equivalent to "death" (you may choose more than one answer; **each answer must be a stand-alone reason**):
   - ❏ Irreversible loss of consciousness
   - ❏ Irreversible loss of the soul or "the essence" of man
   - ❏ Irreversible loss of "personhood"
   - ❏ Irreversible loss of the integration of body functions by the brain
   - ❏ The certainty of cardiac arrest within hours or days
   - ❏ Irreversible destruction of the brain, including the brainstem
   - ❏ Irreversible loss of the function of the entire brain, including the brainstem
   - ❏ Irreversible loss of the critical functions of the entire brain, including the brainstem
   - ❏ Irreversible loss of the capacity for consciousness plus irreversible loss of the capacity to breathe
   - ❏ Further care is futile and/or degrading
   - ❏ None of the above
2. Which of the following objective test results would **not** be compatible with brain death (ie, would prevent you from releasing this patient for organ donation):
   - ❏ Some EEG activity that is not due to artifact
   - ❏ Some visual, somatosensory, or auditory evoked potential activity that is not due to artifact
   - ❏ Some cerebral blood flow on technetium flow study
   - ❏ Normal levels of regulatory pituitary hormones, including TSH, antidiuretic hormone, and others
   - ❏ Normal appearance of brainstem grossly and microscopically (assuming that this could be done)
   - ❏ None of the above
3. After brain death is pronounced, the body is maintained for 48 hours at family request to allow family members to arrive and visit, before organ donation. The clinical findings remain unchanged. After organ donation, an autopsy is done. Which of the following would **not** be compatible with this patient having been brain dead (ie, would have prevented you from releasing this patient for organ donation):
   - ❏ The brainstem appears structurally normal, and microscopically has minimal damage
   - ❏ The cerebral cortex appears structurally normal, and microscopically has minimal damage
   - ❏ The brainstem and cerebral cortex are damaged; however, there are not widespread destructive changes typical of "respirator brain"
   - ❏ There is widespread damage and necrosis (liquefaction) of cerebral hemispheres and brainstem
   - ❏ None of the above
4. An EEG at the time of the second brain death exam shows some residual activity that is not artifact. Another 12 hours later, the clinical exam still shows brain death unequivocally, and the EEG is now isoelectric. When was this patient brain dead (as opposed to dying):
   - ❏ First brain death exam fulfilled
   - ❏ Second brain death exam fulfilled (12 hours after the first exam)
   - ❏ At the time of the isoelectric EEG (12 hours after the second exam)
   - ❏ None of the above
5. The patient is 22 weeks pregnant. A decision is made to continue ventilation and inotropes to support the fetus. After two weeks, the patient is off of inotropes, hemodynamically stable, and remains fully ventilated. Eleven weeks later, a healthy 33-week gestational age neonate is delivered by cesarean section. She still fulfills all the criteria for brain death, and is released for organ donation. When was this patient dead?
   - ❏ First brain death exam fulfilled
   - ❏ Second brain death exam fulfilled (in this case, 12 hours after the first exam)
   - ❏ After delivery of the neonate
   - ❏ After organs are harvested and the ventilator is stopped
   - ❏ None of the above
6. The family cannot accept that the patient is dead with a beating heart, and insists on further intensive care, including ventilation and inotropes. Even on further discussion over the next 12 hours, and with a cerebral blood flow study confirming no flow, the family still insists on continuation of "life support." What do you do?
   - ❏ Tell the family that the patient is legally dead, and that you are going to withdraw ventilation and inotropes at a specified time
   - ❏ Continue support, knowing that the patient will have a cardiac arrest soon and fulfill circulatory criteria for death
   - ❏ Continue full support as long as possible to honor the family wishes, with ongoing discussions with the family
   - ❏ Other: please describe
7. (a) This patient fulfills all brain death criteria unequivocally, including the suitable interval. **Conceptually**, why are they dead (ie, in your own words, what is it about loss of brain function including the brainstem that makes this patient dead)?

   (b) Prior to this survey, had you thought about why, at a conceptual level, brain death is equivalent to death of the patient?
   - ❏ Yes
   - ❏ No
8. Which of the following **best** describes why you are comfortable diagnosing death based on the criteria of brain death (**please only pick one answer for this question**):
   - ❏ The conceptual basis of brain death makes it equivalent to death of the patient
   - ❏ The diagnosis of brain death is an accepted medical standard
   - ❏ The diagnosis of brain death is an accepted legal standard
   - ❏ The diagnosis of brain death was taught to me during my training
   - ❏ I have not thought about exactly why I accept brain death as equivalent to death
   - ❏ I am not comfortable diagnosing death based on the criteria of brain death

Thank you very much for your participation in this survey.

eFigure. Details of the questionnaire. Certain definitions were agreed on a priori for 2 of the survey questions. The first question asked to choose "stand-alone" reason(s) that "is/are an acceptable *conceptual* reason to explain why 'brain death' is equivalent to 'death.'" For analysis, we classified responses into categories that have been discussed in the literature. A higher brain concept of brain death (BD) response was considered any of irreversible loss of consciousness, irreversible loss of the soul or "the essence" of man, or irreversible loss of "personhood." A prognosis concept of BD response was considered any of the certainty of cardiac arrest within hours or days or further care is futile and/or degrading. A statement of loss of brain function response (this is the criterion, and not a concept, to justify why this loss of brain function was death) was considered any of irreversible loss of the function of the entire brain, including the brainstem, or irreversible loss of the critical functions of the entire brain, including the brainstem. Similarly, the seventh question asked "This patient fulfills all brain death criteria unequivocally, including the suitable interval. *Conceptually*, why are they dead (ie, in your own words, what is it about loss of brain function including the brainstem that makes this patient dead)?" We planned to divide responses into the same categories as previously described. After reviewing the returned surveys, the following was used to categorize the narrative responses. A higher brain concept of BD was considered any mention of consciousness, ability to interact, personhood, the soul, the self, or "a unique individual." A loss of integration of body concept of BD was considered any mention of ability to breathe, maintain homeostasis, or maintain integration. A quality-of-life statement was considered any mention of quality of life or "reasonable survival." A prognosis of death being certain statement was considered any mention of inevitable cardiac arrest, "the patient will die soon," or "maintaining life on machines." The quality-of-life and prognosis of death statements were combined as the prognosis concept of BD. Any response that stated only that the brain has died, the patient fulfills the BD criteria, there is no brain function, or BD is an accepted standard was considered a statement (of "fact") only (the criterion, and not a concept, to justify why this loss of brain function was death). EEG indicates electroencephalogram; TSH, thyrotropin.

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